Remarks

Claims 1-29 are now pending in the present application. Claims 1-24 stand rejected. Claims 25-29 are newly added. It is respectfully submitted that the pending claims define allowable subject matter.

Claims 1, 2, 5, 6, 9, 10, 13, 14, 16-18 and 23 are rejected under 35 USC § 103(a) as being unpatentable over Goto (U.S. Patent App. 2004/0165766) in view of Vining (U.S. Patent 5,782,762) and Heckel (U.S. Patent 4,697,178). Claims 3, 4, 7, 8, 11, 12, 15, and 19-22 are rejected under 35 USC § 103(a) as being unpatentable over Goto, Vining, and Heckel and further in view of Argiro (U.S. Patent 5,986,661). Applicants respectfully traverse these rejections for reasons set forth hereafter.

Claim 1 recites, in part, "processing said plane within said volume data set to form multiple enhanced images, the processing configurable to allow processing in real-time while acquiring said ultrasonic volume data set and configurable to allow processing after said ultrasonic volume data set is stored." Independent claim 9 recites, in part, "processing said data set within said plane with image enhancing techniques, the processing configurable to allow processing in real-time while acquiring said data set and configurable to allow processing after said data set is stored." Independent claim 17 recites, in part, "a processor for processing said series of adjacent scan planes, said processor identifying a plane having at least one thickness within said volumetric data set being transverse to said series of adjacent scan planes, said processor processing said plane with image enhancing techniques, said processor configured to process both in real-time while receiving said ultrasound signals and after said volumetric data set is stored."

As discussed previously, both Goto and Vining are directed to processing a volume of data and displaying an image associated with the data. However, neither Goto nor Vining are able to process or include a processor configured to process both in real-time and after the acquired data is stored. Goto and Vining each only disclose processing computed tomography (CT) data after the acquired data is stored. For example, Goto uses CT value counting

memories, shown as MA on FIG. 1, for counting pixels that have a certain CT value or are within a range of CT values. Referring to FIG. 2A of Goto, "all the CT value counting memories MA1 to MAn are cleared in step 41, and a first projection line L1 is set in step 42." (Para. 46, lines 1-3). Pixel values associated with the projection line are read out and added to the appropriate counting memory. Then, in step 44, once all of the projection lines are completed, the process is complete. (Para. 48). Therefore, Goto determines the values of the pixels once and bases any and all subsequent processed images on this determination. Goto thus does not process any data in real-time.

Turning to Vining, Vining acquires the imaging data and then transfers the data to a different work station for processing. Vining states that "[a]fter insufflation, the colon is then scanned, at step 45 of FIG. 1, by a helical CT scanner 22 to produce a series of two-dimensional images 12 of the colon." (Col. 8, lines 35-37). "The set of CT images 12 consisting of up to 500 images is then extracted, at step 50 of FIG. 1, from a database on the computer console 24 in compressed format. Once the data has been extracted, the data is transferred from the console 24 at step 52 to Fig. 1, over a fiberoptic network 25, to a graphics computer work station 26." (Col. 9, lines 10-15). Therefore, Vining also does not process any data in real-time.

In addition, although Vining allows a user to select a slice through a volume, the slice, also referred to as an orthoslice, is selected to aid the user in defining thresholds to be applied to the volume and is not used to present multiple enhanced images simultaneously. The unprocessed orthoslice is displayed simultaneously with a threshold image and the threshold range can be manually adjusted to produce a good match between the thresholded image and the anatomical detail of the orthoslice. (Col. 11, lines 52-57). "The threshold range thus obtained by thresholding the orthoslice is then applied globally to the volume of data at step 79 of FIG. 5 to create a thresholded volume." (Col. 11, lines 65-67). Therefore, Vining displays only one enhanced image at a time that is based on the orthoslice. Furthermore, Vining does not disclose displaying multiple enhanced images based on multiple anatomic features within the slice elsewhere.

Turning to Heckel, the Office Action asserts that Heckel makes up for the deficiencies of both Goto and Vining. Specifically, the Office Action asserts on Page 4 that "it is well known in

the art to perform processing of a perspective view within a volume data set as disclosed by Heckel". Applicants disagree. Initially, Applicants submit that the claim recitation is NOT "processing of a perspective view within a volume data set" as asserted in the Office Action. In contrast, claim 1 recites in part "processing in real-time while acquiring said ultrasonic volume data set and configurable to allow processing after said ultrasonic volume data set is stored." Heckel does not describe processing in real-time while acquiring an ultrasonic volume data set nor does Heckel describe processing in real-time while acquiring any volume data set.

In contrast, Heckel describes a system for "removing hidden surfaces and lines from a perspective display of a three dimensional object." (Col. 6, lines 43-44). To accomplish this, Heckel's system utilizes a high speed raster processor 26 which implements a hidden surface algorithm. More specifically, Heckel describes that "[t]he raster processor 26 includes a pipeline which is multiplexed to respective identical depth buffers 28 and 30. Each depth buffer is loaded with display information to be displayed on the video monitor 25 during one line of scanning for read out during the next line of scanning to cause the display of the three-dimensional scene on the video monitor under the control of video processor 32." (Col. 6, line 68- Col. 7, line 7). That is, Heckel clearly describes a three-dimensional image is first displayed on the video monitor. To display the three-dimensional image, as described by Heckel, the entire image data set must first be acquired and processed by the system prior the image being displayed. Therefore, the initial step of removing hidden surfaces, as described by Heckel is loading the entire data that represents the three-dimensional image into the system and processing the three-dimensional data set in a single operation such that the system can display the three-dimensional image. Heckel does NOT describe that any portion of the three-dimensional data set may be processed and displayed while remaining portions of the three-dimensional data set are still being acquired.

Applicants further submit that would not be obvious to one skilled in the art to configure the processor of Goto to perform processing not only after the ultrasonic data set is stored, but while the data set is stored so that the operator can immediately see the region of interest. As discussed above, Goto and Vining each only disclose processing computed tomography (CT) data after the acquired data is stored. Moreover, Heckel, like Goto and Vining only discloses storing the entire three-dimensional data set in order to display a three-dimensional image.

Heckel then describes that pixels of the displayed three-dimensional image are analyzed by the raster processor 26 to remove hidden surfaces and lines from a perspective display of the three dimensional object. Like Heckel, Goto describes that "after all the data are recorded, the pixel data recorded in the pixel value memories are read out and the data are displayed on a display a perspective image." (Abstract). Both Goto and Heckel receive and store the entire data set. Therefore, neither Goto nor Heckel describe processing an ultrasonic volume data set in real-time while the ultrasonic volume data set is being acquired as recited in the claims. As such, the combination of Goto and Heckel does not describe processing an ultrasonic volume data set in real-time while the ultrasonic volume data set is being acquired as recited in the claims.

Moreover, the Office Action admits on Page 4 that Goto does not describe a processor that is configured to allow processing in real-time. The Office Action then asserts that Heckel makes up for the deficiencies of Goto. That is, the Office Action infers that Heckel describes a processor that is configured to allow processing an ultrasonic volume data set in real-time while acquiring the ultrasonic volume data set as recited in the claims. However, Applicants submit that the Office Action does not provide any citation to Heckel to support the rejection of the claim element. Specifically, the Office Action does not provide any citation to Heckel that Heckel processes an ultrasonic data set, or any other data set, in real-time while the data set is being acquired, as recited in the claims. Applicants therefore submit that in any future Office Action that is not a Notice of Allowance, that the Examiner provides citations to Heckel to support this rejection to allow the Applicants a full and fair opportunity to respond to the rejection. For at least the reasons stated above, claims 1, 9 and 17 are patentable over Goto in view of Vining and Heckel. Claims 2, 5, 6, 10, 13, 14, 16, 18 and 23 depend from claims 1, 9, and 17 respectively. Therefore claims 2, 5, 6, 10, 13, 14, 16, 18 and 23 are submitted to be patentable over the cited art.

The rejection of claims 3, 4, 7, 8, 11, 12, 15, and 19-22 as being unpatentable over Goto, Vining, and Heckel and further in view of Argiro (U.S. Patent 5,986,661).

As discussed above, none of Goto, Vining, and Heckel describe processing an ultrasonic volume data set in real-time while the ultrasonic volume data set is being acquired as recited in the claims. Applicants further submit that Argiro also does not disclose at least any processing

in real-time while acquiring the data set or processing in real-time when receiving ultrasound signals. Instead, Argiro only processes data that has previously been acquired, such as on an Advanced Diagnostic Viewer (ADV), which is a three-dimensional medical imaging workstation (Col. 6, lines 18-21), or other three-dimensional graphics hardware. Argiro states that "[t]he ordering of the work flow permits a user to, inter alia, quickly retrieve data such as ultrasound, CT or MRI data over a network, such as that of a hospital." (Col. 7, lines 52-55). Furthermore, it is submitted that Argiro does not make up for the deficiencies of Goto, Vining, and Heckel. Therefore, claims 1, 9 and 17 are patentable. Claims 3, 4, 7, 8, 11, 12, 15, and 19-22 depend from claims 1, 9 and 17, respectively, and are therefore submitted to be patentable over the cited art.

Moreover, claim 8 recites "identifying thicknesses of said plane for each of said multiple enhanced images" and "wherein the processing said plane within said volume data set being based on said thicknesses, each of said multiple enhanced images being based on a different thickness." The Office Action admits on Page 4 that Goto only describes the use of ultrasound data. Applicants submit that Argiro fails to make up for the deficiencies of Goto with respect to the rejected claims. Specifically, Argiro adjusts the thickness of all of the displayed slices simultaneously, stating that "thickness slider 300 permits a user to enlarge the size of the slices shown in the MPR views of subwindows 310, 312 and 316" (Col. 23, lines 23-25). Therefore, Argiro is silent with respect to identifying a different thickness for each plane.

With respect to claim 12, claim 12 recites "identifying a depth based on said data set, said plane having different thicknesses based on at least one of said depth and said different image enhancing techniques." Dependent claim 19 recites "an input for identifying the plane within said volumetric data set; said processor identifying a depth based on said volumetric data set" and "at least one thickness control setting said at least one thickness based on at least one of said depth and said image enhancing techniques." Argiro, however, states that "[w]hen examination viewer component 114 is first entered from image gallery component 112, the MPR two-dimensional images automatically show the middle slice of the viewing orientation." (Col. 22, lines 44-47). Therefore, Argiro does not identify a depth based on the data set, but instead uses the same depth, the middle slice, for presenting all data sets. Also, as Argiro does not identify the depth, Argiro does not disclose the recitation of having different thicknesses based on at least

one of said depth and said different image enhancing techniques nor the recitation of setting at least one thickness based on at least one of said depth and said image enhancing techniques.

Dependent claim 22 recites, in part, "said transducer further comprising having a transducer type, said processor further comprising identifying a subset of said image enhancing techniques based on said transducer type." Argiro is not concerned with a transducer type and does not disclose identifying a subset of said image enhancing techniques based on said transducer type. For at least the reasons stated above, Applicants submit that claims 3, 4, 7, 8, 11, 12, 15, and 19-22 are patentable over the cited art.

Applicants further submit that the dependent claims recite additional subject matter neither anticipated nor rendered obvious by the cited prior art. Moreover, the dependent claims are allowable based at least on the dependency of these claims from the independent claims.

In view of the foregoing comments, it is respectfully submitted that the cited references neither anticipate nor render obvious the claimed invention. Should anything remain in order to place the present application in condition for allowance, the Examiner is kindly invited to contact the undersigned at the telephone number listed below.

Respectfully Submitted,

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